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JAN 24 1892 SPECIAL REPORT

U. S. Department of Agriculture.

OF THE

ASSISTANT SECRETARY OF AGRICULTURE

FOR

1892.

DUTIES OF THE ASSISTANT SECRETARY.

REVIEW OF THE WORK, 1889-'92.

FROM THE REPORT OF THE SECRETARY OF AGRICULTURE FOR 1892.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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SPECIAL REPORT OF THE ASSISTANT SECRETARY.

SIR: I have the honor to submit herewith a review of the duties of the Assistant Secretary of Agriculture, together with a report of the work accomplished during the last four years by the divisions which were by your order placed under my direct supervision.

Very respectfully,

EDWIN WILLITS,
Assistant Secretary.

Hon. J. M. RUSK,
Secretary.

DUTIES OF THE ASSISTANT SECRETARY.

This Department became one of the Executive Departments of the Government by act approved February 9, 1889. By the same act the office of the Assistant Secretary was created, but no appointment was made to it till March 29, 1889, when I was honored with the position, entering upon my duties April 24, 1889. Under the law I was to have such duties as should be assigned to me by the Secretary. It was generally understood that in the division of the labor I should have the primary administration of the scientific work, and should be charged with consideration of it wherever it might be found. But the special divisions assigned to me at first will appear by the following order:

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 26, 1889.

In accordance with section 2 of the act entitled "An act to enlarge the powers and duties of the Department of Agriculture, and to create an Executive Department to be known as the Department of Agriculture," approved February 9, 1889, the following assignments and duties are hereby prescribed to the Assistant Secretary of Agriculture, and the following order is promulgated in accordance therewith, to take effect at once:

The following-named divisions, and sections thereof, are hereby transferred to the office of the Assistant Secretary, subject to the reservations hereinafter mentioned:

The Botanical Division, and the Section of Vegetable Pathology.

The Pomological Division.

The Microscopical Division.

The Chemical Division.

The Ornithological Division.

The Forestry Division.

The Entomological Division, and the Silk Section.

The Office of Experiment Stations.

The Assistant Secretary will, in general, control and direct the scientific policy and operations of the above-named divisions, and sections thereof, and all questions and correspondence involving the scientific work of said divisions and sections will be submitted to him for approval and signature.

All questions relating to the scientific operation and policy of the above-mentioned divisions, but in which questions of administrative policy are involved, shall, primarily, be matters for the consideration of the Assistant Secretary, but shall be submitted to the Secretary for his approval before final action is taken.

All matters considered by and all correspondence originating in either of the above-mentioned divisions, in which only an administrative feature or policy is involved, will be referred to and prepared for the approval of the Secretary, as heretofore.

The investigations and experiments in the manufacture of sugar from sorghum, etc., are excepted from the above order.

J. M. RUSK,
Secretary.

Subsequently were added the charge of the Library and the Museum. In time the Section of Vegetable Pathology became a division, and the Silk Section was separated from the division with which it had been connected, and both reported to the Assistant Secretary. Other special investigations and matters were included under my supervision, such as Artesian Wells and Irrigation, Fiber Investigation, Rainfall Experiments, and the Exhibit of this Department at the World's Columbian Exposition. I was supposed to be conversant with the work of all these divisions, investigations, and matters; to keep careful watch of the funds appropriated for their use, and to know every item of expenditure connected therewith; to personally know the persons and the work of every employee engaged; to be in touch with every line of scientific inquiry, so as to be able to consult with and advise the chiefs of the several divisions, and to report at any time verbally or in writing to the Secretary or any committee in Congress the status of every matter under my supervision. I was held responsible for every report, bulletin, or publication issued by any chief, officer, or subordinate under my charge; to see that the matter was clear and concise; that it was of such character as would warrant publication; that it should be free from controversy or any reflection or imputation upon other workers in the Department, or any unjustifiable criticisms of the acts or motives of persons or officers out of it. I was to coördinate the work of the several divisions, or inquiries, so far as I might be able, to avoid duplication, either in lines of work or in publications, and thereby to bring about a harmonious coöperation in the Department.

These duties necessarily brought to my table for consideration matters and topics which could not be referred to any one division or any one person, but should draw upon every resource in the Department. The

study of the effect of climate and soil and seed upon productions; the variety of grain or grass or forage plants or vegetables adapted to localities; where to buy and when to distribute; matters relating to flax and other vegetable fibers, to wool and cotton, to fruits and their distribution, to injurious insects and diseases; and an innumerable line of special investigations, to be made by me or through me, by many others, to make a complete whole, found place at my desk.

It is perhaps superfluous to remark, after the foregoing partial statement of the supposed duties of the Assistant Secretary, that the position is not a sinecure. In fact, it took but a short time to demonstrate that no one man could efficiently carry on all the matters charged to his personal supervision. Some relief came to him in the forming of an Editorial Division, which very materially assisted him in the review, under his general directions, of the publications issued by the divisions under his charge. This was by far the largest single burden imposed upon him, and he can testify to the very efficient aid the able gentlemen connected with that division rendered him. This will be more apparent from the statement of the number and size of the publications given out by the Department, as appears in the reports of the Division of Records and Editing for 1890, from page 442 to page 447; in that for 1891, from page 492 to page 498; in that for 1892, in the report of the chief of that division, as given in this volume.

The burden of this supervision was great at the beginning of the administration, but has year by year increased in a ratio corresponding to the increase of the work of the Department and its appreciation by the public as shown by its demands for its bulletins on special subjects.

This increase is best shown by the fact that the total number of pages of the bulletins issued by the Department during the year 1888 numbered less than 20,000,000, these figures representing, of course, not only the total number of bulletins, but the total number of copies of each bulletin. In 1889 this amount was more than doubled, trebled in 1890, while for the year 1891 it was 123,000,000 and for 1892, up to December, the figures reached more than 100,000,000 pages of printed matter. The Secretary's Annual Reports, running from 550 to 700 pages, with editions each of 400,000 copies, are not included in this statement, nor are the Annual Reports of the Bureau of Animal Industry and of the Weather Bureau.

I may add here the fact that, while there has been a marked increase in the sum appropriated for the printing of this Department, the increase in the amount of printing done has greatly exceeded the increase in amount of appropriation. For instance, whereas the amount of printing done in 1892 was five times greater than in 1888, the amount of the appropriation available in 1892 was only two and a half times as great as in 1888.

This increased number and variety of publications were rendered possible by increased appropriations both for work and for printing.

It may not be out of place to record here a statement which will show the consideration of Congress for the work of the Department as expressed in the sums allotted to it. There were appropriated, including deficiencies and the sums allotted for printing—

For 1882	\$371,500.00
For 1883	487,780.00
For 1884	428,140.00
For 1885	677,690.00
For 1886	598,452.50
For 1887	673,758.85
For 1888	1,046,730.00
For 1889 (including \$595,000 for Experiment Stations).....	1,770,154.03
For 1890 (including \$600,000 for Experiment Stations).....	1,736,005.45
For 1891 (including \$675,000 for Experiment Stations).....	1,878,900.00
For 1892 (including \$728,000 for Experiment Stations, and \$889,753.50 for Weather Bureau)	3,113,153.50
For 1893 (including \$728,000 for Experiment Stations, and \$913,660.72 for Weather Bureau)	3,323,060.72

The appropriations for Experiment Stations are carried on our appropriations for the convenience of the Treasury officials.

The sums allotted for printing do not include the \$200,000, which, for several years past, Congress has annually appropriated for the printing of the 400,000 copies of the Secretary's Annual Report, mainly for its own distribution, nor for the special reports ordered printed for the same purpose generally in large editions.

The general appropriations, however, included many special items worthy of notice. For fiber investigations in 1891, \$4,000; 1892, \$10,000; 1893, \$5,000. For investigations and reports on artesian wells and irrigation in 1890, \$20,000; 1891, \$40,000; 1892, \$10,000; 1893, \$6,000. For cotton bollworm for the years 1891, 1892, 1893, \$2,500 each. For corn products abroad in 1892, \$2,500; 1893, \$10,000. For investigations of peach yellows and other diseases for the four years ending June 30, 1892, \$10,000 each year; for 1893, \$15,000. For reports on adulteration of food in 1890, \$5,000; 1891, \$10,000; 1892 and 1893, \$12,500 each. For grass and forage experiments in 1889, \$5,000; 1890, \$8,000; 1891, \$15,000; 1892, \$15,000; 1893, \$7,500. For meat inspection in 1892, \$150,000; 1893, \$350,000. For experiments in the manufacture of sugar in 1890, \$25,000; 1891, \$50,000; 1892, \$60,000; 1893, \$20,000. For experiments in producing rainfall in 1892, \$7,000; 1893, \$10,000.

Nearly all the work done under these appropriations, and for which so much printing was ordered, was performed by experts in the various lines of work. At least one-half of the time of the chiefs and assistant chiefs of the respective divisions was, however, taken up in correspondence, either in person or through subordinates, relative to their technical and practical work. From year to year the appreciation of the public of this work can be measured by the increasing demand for the publications and by the almost numberless inquiries, nearly all of a practical nature, from a very large percentage of 60,000,000 of people.

They have important interests which they are energetically pushing to a successful issue, but they are meeting with the obstacles common to agriculture, in the nature of diseases and insects and other disabilities, and they are desirous of learning the best methods and the best material for a higher and better agricultural production. As has been repeatedly stated, many of these inquiries involve a large amount of work and investigation, and the answer to a single letter will frequently involve a week's labor. As a rule, the Department is able to give a satisfactory answer and to render valuable assistance.

In the matter of this growing appreciation, I may add that the back numbers of reports and bulletins, which for a time were stored away, have, within the last three years, been called for to such an extent that in large measure this supply has been exhausted. It is now practically impossible to secure anywhere a complete list of the publications of this Department. They would make a small library of themselves. The requests for these full sets are increasing with every year, and with reason; for this Department has not been in existence for forty years without having recorded experiments and information on a large number of subjects which, in the nature of things, repeat themselves, and it is important that, in a new experiment, with added facilities and modern research and scientific appliances, we should be able to take into consideration the work heretofore done on the same subject, and the time is not far distant—in fact, I may say is now at hand—when the charge can not be made that these reports and bulletins are fitted only for the waste-paper basket, and the challenge may be made, without fear of contradiction, that every report and bulletin issued by this Department, placed in proper hands, is worth all it has cost. The misfortune is that in the distribution of these documents reliable information as to the proper parties, *i. e.*, parties who will carefully and thoroughly examine them, is hard to obtain. In times past a large portion of them were distributed indiscriminately, and of course were of practically no use to many of the parties receiving them. By a gradual process of elimination and by the increasing number of requests of applicants, we are more and more sure that they are falling into the proper hands. There is, however, still much to be done in this direction. No person not conversant with the difficulties of having reliable and proper lists has any conception of the difficulty involved in this gratuitous distribution of public documents. There are so many people who feel that, if they can get a document free of charge, whether they really need it or not, they may as well exercise their rights as citizens to demand something from the Government or the Department for whose support they are taxed. It frequently happens, moreover, that when a valuable document has been issued, to which the attention of the public is more especially invited, numerous applications are made through a Senator or Representative, or through both Senators and several Representatives, so that they may secure duplicates which may be turned over to

second-hand book stores for sale. Frequently these applications are made also to the chiefs of all or nearly all the divisions, and to some official or several officials of the Department, the applicant hoping thereby to secure, through their influence, several copies. Nothing but a well-prepared index can prevent this, at times almost wholesale, distribution of documents to a single person. I will simply add that, though great progress has been made in this matter in the last four years, there is still need for a more complete and perfect system; or rather the system now in use is susceptible of great improvement.

GENERAL REVIEW OF THE WORK FOR THE LAST FOUR YEARS.

The effort will be to make this review as concise as possible, reference being made, for a more enlarged description of the subjects, to the reports on these subjects in the annual reports and bulletins. I shall first make some few notes relating to the work of the several divisions.

DIVISION OF BOTANY.

The scientific work proper of this division has brought it into wide public notice, both at home and abroad. The work of collecting, classifying, mounting, and assigning to the Herbarium of the flora of this and other countries has increased to such an extent, and the stores thereby collected have become so ample, that public attention has been arrested, and the world is beginning to appreciate that we are fast winning a standing as a National Herbarium. The work of the division may be divided into three parts: First, the scientific collection and classification of specimens for the Herbarium; second, the distribution of plants already classified and known to the agricultural colleges and experiment stations and other scientific institutions, and the exchange of plants with other herbaria; and, third, the conducting of experiments with grasses and forage plants.

The work under the first head has already been alluded to, but it is desirable that something further should be said about the character and extent of this collection of plants. The United States is topographically a very large country, and includes within its bounds many regions of considerable extent that are practically unexplored and unknown, especially botanically. For the last fifty years or more it has been the field for extensive botanical explorations by foreign governments, and it may seem strange that the herbaria of some of the European countries contain plants unknown to or not to be found in the herbaria of this country. It is not an uncommon thing for botanical students to find it necessary to go to Europe for information as to the plants of our own country. The effort of this Department is to secure, as soon as may be, a thorough collection and classification of our flora. Some parts of the country have been systematically and fairly well explored, but it may be said that as a whole we have made but a fair beginning. Up to four years

ago this collection had been more or less sporadic, by individual botanists engaged by this Department, or by special agents sent out into detached places, generally of convenient access, but not with the idea of thoroughly and exhaustively collecting or noting the existence of everything within a certain region. The effort has been made to consolidate this work and to take up the least-known regions. In pursuance of this policy a comparatively thorough collection has been made through Texas, which, up to a few years ago, was practically unknown, and more or less systematic explorations of the Territories of New Mexico, Arizona, and southern California, have been made. An elaborate and systematic exploration was made in 1891-'92 of the Death Valley, in southern California, ranging over the borders into Utah—a region of 100 miles square before that practically unknown. Also last year a similar exploration was made of northwestern Idaho and eastern Washington. These systematic explorations were conducted with all the appliances for noting the altitude, temperature, and characteristics of soil and climate in which the plants grew. The information derived and the flora collected in these two expeditions were a complete vindication of the policy adopted, not only in the number of plants collected, but in the data relating to their growth. And it is my judgment that in the future, so far as it may be practicable, the country should be covered thoroughly by this systematic work, beginning first at the least-known localities.

Under the second head, large amounts of plants, systematically arranged and classified, have been sent to the institutions of this country and have, in the last four years, been of great benefit, especially to the new agricultural colleges and experiment stations. The plants so distributed, carefully mounted, become an object lesson and a standard for the work done by these institutions themselves.

The work under the third division needs more than a passing notice. I have in my first report referred to the importance of the forage question, and I need add nothing on this point save to again express my opinion that the production of grasses and forage plants is of more importance to this country than any other line of productiveness; worth more to the South than cotton, to the West than gold and silver, and to the North than wheat and corn. The effort of the Division of Botany during the last four years has been sharply directed to this point. Arrangements were made in 1889 for the possession for five years of a tract of land of 240 acres in the vicinity of Garden City, Kans., at about the one hundred and first degree of longitude west. The region is classified as the semiarid, with sufficient rainfall, perhaps, for the cultivation of cereals and annuals, provided it came at the proper season, but being distributed through the whole year is necessarily so small in amount as to prevent successful agricultural operations. The problem was to find a grass or forage plant that would grow successfully in such a climate without irrigation. An experimental grass and forage station was established there in 1889, and has therefore been in opera-

tion four years—a time sufficient to enable us to take our bearings as to results. The first experiments naturally were with seeds already known and in use, which could be bought in the open market, to determine what could be done by their careful cultivation in said locality; next, to obtain from other countries seeds of plants cultivated in regions of a similar character; and, thirdly, the collection of seeds of native grasses and forage plants growing in the great West itself under similar conditions. These had to be collected by hand at the time of maturing, by skilled botanists, and for three years these seeds have been so collected in New Mexico, Kansas, Colorado, and the Dakotas. Manifestly these seeds will be first planted the year subsequent to their being gathered. The result is that at most we have had but three years' experience with them. The same may be said with reference to those gathered abroad. At first all, or nearly all, the seeds were sown in comparatively small plats and experiments were made with different kinds of care and cultivation adapted to the locality, and then on wider areas of 1 acre up to 20 or more. It soon became evident that the ordinary grasses and forage plants in use at the East would not thrive successfully in that region under any cultivation, and that reliance must be had upon foreign and native seeds grown in regions of like conditions. It will suffice to say that the report for 1892 will show that one foreign plant, the *Bromus inermis*, which comes from the semi-arid portions of Austria, is the only one from abroad that has proved an absolute success up to this time. Many others from abroad are of great promise, some of those from Australia being considered especially hopeful. Of the native grasses, three have been proved to a demonstration to be of great value.

The results of the experiments with these four grasses alone are, in my judgment, an ample compensation for all that has been expended on the Garden City Station, and I am hopeful that there are at least twenty varieties that will demonstrate their usefulness the coming season. It was my opinion that the five years' experiments at Garden City would be the extent to which the experimentation should be carried, but I shall reserve my final judgment in the matter until the results of the experiments for 1893 shall come in. It will be noticed that these experiments, beginning first with small plats and then extending into fields, covered the two conditions that are deemed essential for absolutely successful determination. I can not concur in the opinion which is so prevalent among our scientific experimenters that the successful use of any plant can be determined in a carefully-prepared small plat of ground. Its economic use is only demonstrated when applied to large fields under ordinary though careful cultivation.

Reference is here made to the report of the Division of Botany, which may be found elsewhere in this volume, as to the other operations at Garden City which I have not covered in this brief sketch. The

results show that there are millions of acres on the border land between successful cultivation and the desert region, heretofore classed as unproductive, which are susceptible of successful agriculture with plants and cereals adapted to the climate. This was, in a sense, believed heretofore in a sort of intangible way, but is now proved to a demonstration.

In addition to the operations of the Garden City Station, conducted by the Department itself, an effort, more or less successful, has been made to elicit and stimulate the interest of the experiment stations in the same subject. Allotments were made of money to be expended in the respective stations under our direction, and mainly with seeds furnished by this Department, to the stations of North Dakota, South Dakota, Wyoming, Utah, Arizona, New Mexico, Louisiana, Mississippi, Georgia, Florida, and North Carolina. These efforts, while not so successful as was to have been hoped, yet resulted in a positive direction of the energies of these new stations toward the propagation of forage plants, and we shall have to look to the future, in a measure, for these results. The stations were too newly organized to give the work the needed time and attention, especially in the West. In the South there has been manifested a very greatly increased interest in the subject, to be traced directly to the efforts of this Department through the action of the several stations. From the first the Mississippi Station was made the center of operations, and there have been propagated as an experiment a great many kinds of plants especially adapted to southern needs. From the constant elimination of those which were found not so adapted and the continued experimentation with those which were more successful, much desirable information has been promulgated, and the successful cultivation of many plants found to be possible. The interest in this subject has increased at least a hundredfold in the South in the last three years, and I believe that at no distant future the South can be clothed with a verdure that shall completely redeem its waste places, shall call a halt to growing sterility, and shall more widely and successfully promote the cattle and sheep industry. Take it altogether, the prospect of the South for a larger variety of production and a greater diversity of industry is most flattering; and the future of the "new South," so called, depends upon the permanent adoption and cultivation throughout its whole area of a successful line of forage plants—more so than upon its mines and manufactures.

DIVISION OF ENTOMOLOGY.

The year 1889 marks the successful advent of the Australian *Vedalia cardinalis* in the orange groves of southern California, where, as a parasite, it most successfully destroyed the fluted scale. The destruction of the orange groves by the scale insect, which was impending in 1887-'88 on my visit to California, was stayed, and without exaggeration it may be said that the importation of this one parasite has saved to the country

millions of dollars. Other scale insects, of which *Vedalia* is not a parasite, still exist and do great injury to the citrus industry, but not to the destructive extent of the fluted or white scale. These have been combated by agents of the Department and by horticulturists in California in various ways, not with entire success, however, and a recent effort has been made by this Department in coöperation with the State Board of Horticulture of California, to import parasites to combat those other varieties—with what success has not, at this date, been demonstrated, though it is claimed with strong hope. The field of operations of the Division of Entomology is so broad, the work is so varied, and the insects so multitudinous that it is impossible in this brief statement to make many specific notes of the character of the foregoing. There are coming to the front so many insects, either indigenous or imported, that it has been almost impossible for the Division of Entomology to compass their life history and habits. Insects that ten years ago were not pests have become such under new conditions and in new localities. An excessive rainfall may nurture into life an insect supposed heretofore to be harmless to vegetation. On the other hand, an extreme drought will develop to an amazing degree an injury hitherto unknown. The country is so vast, the conditions so varied, and the climate so changeable that the most skillful entomologist can scarcely keep pace with the growing demand for investigation and information. The application of sprays, so vigorously advocated and so successfully promoted by this division, has been of incalculable benefit to agriculture in this country. The fact that the Entomologist, from years of observation and experience, is able by a simple letter or bulletin to appease the alarm of a region over the advent to the locality of an insect hitherto unknown to it, by showing that the destruction is only temporary and caused by some condition of weather or climate, has been in the last four years of invaluable assistance to agriculture. The farmer with this assurance in mind, though suffering present affliction, can with confidence plow and sow for the future. There have been repeated instances of their character, which should be placed to the credit of the division, though in the general estimation they may be lost sight of. The advice the Entomologist is able to give, on the other hand, as to time, season, and methods for the destruction, in whole or in part, of destructive insects, has also, whenever followed, been of vast benefit to horticulture and agriculture.

DIVISION OF ORNITHOLOGY AND MAMMALOLOGY.

The work of this division, as heretofore stated by me, is of two classes. First, the practical one of the study of the habits of birds and mammals injurious or beneficial to agriculture. A large amount of work has been done in this line and a vast amount of data has been collected which, when published, will give absolute information as to the extent of such injury or benefit, and the best methods of combating the one or pro-

moting the other. I wish to speak, however, more specifically in reference to the second line of work. It may be considered biological, as to the scope of its inquiries, and covers the whole biological field, including not only birds and mammals, but vegetation as well. In its deductions it covers the botanical, as well as the animal world, and in the last three years there has been considerable coöperation between this division and the Division of Botany. The Division of Botany, as it has been observed, in its collections is not limited to the collection of plants, but takes note of the locality, altitude, temperature, rainfall, under which they occur—data which are similar to the data taken in collections of this division—so that between the two there has been hearty and systematic coöperation. The problem is the distribution of animal and vegetable life, so that, the conditions of climate and soil being known, *a priori* may be known what plants and animals will successfully exist in a distinctive locality, region, altitude, or latitude. On broad lines this is more or less known now. It is known, for instance, that oranges will not grow in the open air in Michigan; but a distinctive, systematic knowledge of all the localities in the United States, as to the possibilities of animal and vegetable life, has not been obtained. The law of this distribution is undefined, and I consider that one of the most important scientific investigations now being conducted in the U. S. Department of Agriculture is this biological study. It has been the effort of the Assistant Secretary to coördinate this work in all the branches in any degree impinging upon this question. The law of climate runs through all the divisions; it is found in the distribution of fruits, of insects, of birds, and of vegetable and animal diseases; it is found in that universal effort of life to adapt itself to changed environments. Given accurate information as to the climate and soil of a new region, biology can with reasonable assurance indicate the species which may be successfully introduced. In fact, I consider this the most important single inquiry—the most far-reaching and the most likely to produce ultimate permanent results—that is now being carried on in the Department. The incorporation of the Weather Bureau with this Department opens up a wide field of observation and study that will be ultimately of vastly more benefit to agriculture in coöperation with the other divisions of the Department than the announcement of storms and the daily prediction of the weather. The study of the climate and its effects has become so fixed in the Department within the last two years that it is sincerely to be hoped that no halt shall be made in this line of work, and I speak of this in connection with my remarks on the work of this division for the reason that four years ago, on the beginning of my administration here, I found this class of work done almost exclusively in this division; that is, as a special point to be made, and having, prior to my acceptance of my present trust, paid considerable attention to the subject (in an incidental way, however), I unqualifiedly indorsed the work being done, and have facili-

tated it in every way possible by coördinating the work of the other divisions and by encouraging it by word and deed. I again repeat that it is to be hoped that this line of work shall not cease, but shall in the future be encouraged and developed.

DIVISION OF VEGETABLE PATHOLOGY.

This division, as heretofore stated, was simply a section of the Division of Botany in 1889. Subsequently its work took so wide a scope that it was deemed best to make it a separate and independent division. Its work is surrounded by much the same difficulties that exist in that of the Division of Entomology. It is impossible to keep pace with all the new diseases afflicting vegetation, some of which are extremely destructive. The peach yellows is of comparatively recent origin, at least in its sweepingly destructive effects. The vine disease of southern California, which blasted so many of its vineyards, was unknown a few years ago. The orange blight, now afflicting Florida, has come to public notice only within the last two years. The pear blight came into the field within the memory of men not far advanced in life, and, in fact, almost all of the diseases have made their appearance or have assumed destructive proportions in the last quarter of a century. This division has taken hold of all these diseases with a will. By experiments in the field, by work in the laboratory, it has demonstrated the high order of its intelligence and administration. As in the Division of Entomology, great results have come from spraying. So, too, in like degree, are seen the benefits of spraying the mixtures devised or promoted by this division—benefits which may well be counted invaluable. A recent computation, made from reports from vine-growers in only a limited portion of the United States, based upon what they had saved by the use of a single mixture, according to rules laid down by this division, showed that the benefits for that one season, to their single industry alone, had a money value far in excess of what the division has cost the Government since its organization. Many of the diseases are very elusive. We do not yet know what is the cause of peach yellows, nor of orange blight, nor of pear blight, nor of the vine disease in southern California. There seems to be no question that the experiments of this division demonstrate the fact that these diseases are contagious, and are not simply the outgrowth of defective nutrition and the immature growth and impaired vitality of the plant. Elaborate experiments have demonstrated what they are not, thereby restricting the field for future investigation. It has successfully shown that budding from a diseased tree to a healthy one does produce the disease in the latter. Investigations in the laboratory and special studies of the life history and conditions of these diseases are being carried on by the most skillful experts, with the best obtainable appliances, to determine absolutely the cause in the first instance, and

then, if possible, to devise a remedy. It may take years, but I firmly believe that a satisfactory solution of many of these problems is in the near future.

DIVISION OF FORESTRY.

There has been a marked advance in forestry sentiment in the last four years. The work in the Division of Forestry is beginning to be felt and more extensively appreciated. It has not been confined simply to the gathering of data as to the effect of deforestation and the best methods of reforestation, nor to the effort to secure data of the distribution in lumber measure of the various kinds of timber in the United States, which has yet by no means been neglected, but has been a factor in the gathering of information as to the proper selection of reservations in the great West. It has entered upon a more important inquiry as to the relative strength of timber for constructive and architectural purposes, and in this line is being so thoroughly appreciated by architects in wood and constructors of bridges and large buildings that there has come to the support of its work an entirely new class of advocates. The support four years ago was largely sentiment, based upon the maxim "Woodman, spare that tree." Now, added to that, is the strong, practical sense of the manufacturing and constructive interests of the country, and of that large body of agriculturists, constantly increasing in the great West, whose products are so largely dependent upon irrigation, the source of which lies in the mountains now covered by forests. The direct benefit of these forests to the water supply is so apparent that the Division of Forestry is being consulted as an authority on the subject. This appreciation justifies the belief that this division has before it a growth far more rapid than in the past. Heretofore, in the eastern portions of the continent the sentiment has been largely in favor of cutting down and destroying the forests rather than their perpetuation, but the time has come when even in regions east of the Mississippi River the changes of climate and the unwonted and sudden freshets have called the attention of all thoughtful men to the principal causes of the changed conditions. As the country has settled up west of the Mississippi River in regions but recently classed as desert with no supposed agricultural possibilities, the subject of water rather than land has become predominant, and the preservation of the forests on the mountain sides and along the streams is being considered not simply desirable, but necessary; so that the East and the West, so different in their physical conditions, are now joining hands in the forest enterprise, and in a comparatively short period the subject of the preservation and systematic use of the forests and the best methods of restoring them will be one of the most important questions of the time.

DIVISION OF POMOLOGY.

The work before this division is one of the most difficult, and, as now organized, is so incomplete because of the lack of funds that it can not be satisfactorily described. The fruits of the country are almost innumerable in their species and varieties. New varieties are being propagated at a rate so much faster than any single division can keep pace with, that it is almost discouraging. One important function of the division is the identifying and naming of fruits. So many of the supposed new varieties are simply abnormal growths of the old, or with the changes in character and form produced by the different conditions of climate and culture, that it is almost impossible to detect the synonymous features. There is hardly a plant that by processes known to the skillful horticulturist or gardener can not be made to assume characteristics which shall mislead the innocent and unwary, and this division should be so fully equipped in men, material, and appliances that it may become a check against the delusive wiles of the pomological speculator. The division, having no laboratory and no experimental grounds, can not apply the tests that would render its decisions authoritative. It is, therefore, limited to gathering such data as it can from the experiments of others. It should charge itself also with collecting information relating to the number, labors, and products of all the fruit-growers of the country, with the well-known characteristics of the different regions. It should charge itself with the study of the fruits best adapted to all localities, with the distribution of the same according to climates and soil, and with the changes that obtain with changed conditions.

The division, so far as it has been able to do so, has labored in all these directions, and is accumulating data and material that shall enable it, when more adequate funds are granted, to handle all these questions authoritatively, which will be of vast benefit to the fruit industry. Its work has been most efficient, so far as it has gone along the lines indicated, and within the four years it is manifest that its purposes and efforts have assumed more definite plans. It has become recognized by the horticulturists of the country as a positive factor in their work.

DIVISIONS OF CHEMISTRY AND MICROSCOPY AND THE OFFICE OF
EXPERIMENT STATIONS.

The Division of Chemistry, the Division of Microscopy, and the Office of Experiment Stations were so fully treated in my former report that I have but little to add. The first has more distinctly assumed the attitude of coöperation with the work of other divisions, and has associated with its distinctively chemical work for comparison results of bacteriological study, as conducted by other divisions, and to a certain extent by itself, and its work is assuming that comprehensive

character that may in time solve some of the questions that chemistry itself has been found insufficient to solve. It has become apparent that chemistry can not traverse all of the elements of plant growth nor all the conditions of animal nutrition. Chemical changes are wrought by bacteria, digestion is promoted to such an extent by the active energy of the life principle, whether in plant or in animal, that chemistry is only one of the coördinate branches in the comprehensive study of the whole. There has been substantial progress, therefore, along the line of modern investigation in this regard, and this hearty coöperation is more distinctively a feature marking the work of the last four years. The Division of Microscopy has simply added to its labors the investigations made necessary by new inventions, new manipulations, and new discoveries in arts founded upon agricultural production. The Office of Experiment Stations, whose existence is coincident with this administration, has established its line of work. Its hearty coöperation with the experiment stations of the different States has won their regard, and its labors have justified the allotment of duties to it by Congress and by the Department.

FIBER INVESTIGATION.

It will be noted that the first appropriation for this investigation was made in 1891. These investigations have been largely specific, directed toward flax, ramie, and sisal hemp. A special study has been made of the conditions of each one of these—flax as a product of the Northern and Western States and ramie and sisal hemp for the South. The possibilities of producing flax that shall rival the best of Europe has been demonstrated, and all that is needed to establish the industry on a most thoroughly competitive basis is a division of labor between the flax-producer and the flax-manufacturer; carried on by each by better and more economic methods. In the past the farmer did his own retting and scutching. Neither of these are agricultural processes and should be done by a distinct line of operatives. Manufacturers should encourage this division of labor into an intermediate branch, so that the farmer should find a market for his raw material at the doors of the new industry that shall manufacture it into the most approved fiber. These conditions existing, with appropriate legislation that shall encourage its culture, millions of acres can be devoted to a product now comparatively abandoned, thereby bringing a very much needed diversification to agriculture. The study of ramie culture is still crippled by the as yet unsolved question of processes and machines for its decortication. It can be produced in this country of a quality that shall rival that of India and China; but the tests made by this Department of the machines and processes now existing are not flattering, and assurances can not be given that success is near at hand. Better results are apparent in the culture of sisal hemp. This is a product largely raised in and exported from Yucatan. It is our supply in large degree

of material for cordage and binding twine. It was supposed that it could not be raised in this country, but it is fast becoming demonstrated that it can be successfully produced in southern Florida. The southern half of that State has wonderful possibilities in store for it, not only relating to fibers, but to sugar cane and semitropical fruits. The production of fibers is not the least of its possibilities. Even if this fiber inquiry should proceed no further, sufficient data have been collected to warrant us in the belief that experience and appropriate legislation will save to the country many millions of dollars now expended in the purchase of commodities and materials abroad which might be produced at home.

ARTESIAN WELLS AND IRRIGATION.

It will be observed that the first appropriation for this inquiry was made in 1890. It will be remembered that in the remarks relating to the Division of Forestry the fact was noted that in the great West it was a question of water rather than of land. This water is sometimes found in subterranean channels and sometimes on the surface. That on the surface is utilized by dams, reservoirs, main and distributing canals. The underflow waters are reached by artesian-wells, large numbers of which overflow at the surface, and others reaching so near that they can be easily raised by pumps driven by windmills or cheap machinery. The investigation has, therefore, taken two lines: (1) As to the extent of country which may be considered the artesian-well region, a large portion of which is away from and beyond the reach of the surface streams. The principal investigation of these artesian basins was along the foothills of the Rocky Mountains, and it has been found that from the British possessions almost to the Gulf of Mexico there is a supply of this underflow water, in some places most marvelous in amount, which, used to supplement the natural rainfall, will add hundreds of thousands of square miles to possible agricultural cultivation. (2) The Anglo-Saxon race know nothing of irrigation. Its home has always been, until recent years, exclusively in the rainy regions. The first seventy-five years after the adoption of our Constitution little thought was given to the subject of irrigation. As the country developed and its migration passed beyond the Missouri it met altogether another civilization—another system of agriculture. The Mexican irrigation ditch, as borrowed from Spain, was a surprise and in some respects a revelation. The marvelous production of a single acre and the possibilities of support to a single family that can be found in a home of 5 acres by the simple control and appropriate distribution of water made a profound impression upon the Anglo-Saxon mind, and during the last twenty-five years the practical energies of this indomitable race have been thrown into the irrigation question. Congress, realizing that this was in a sense a new agricultural question, very properly charged the Department of Agriculture with its consideration, not only

for the West itself, but for the East as well. There are seasons when the use of a little water properly distributed will add largely to the products east of the Mississippi River. It is a live question, and the reports already made by this Department have proved of great value, and it is to be hoped that the Department may have firmly established, as a part of its work, the duty of considering it in all its bearings, and the giving of information of the best methods of using for agriculture the waters that are running to waste to the sea. Wise statesmanship should foresee the necessities of this country from sea to sea, with a population possibly increased threefold in the next one hundred years. No fear of competition with the products of the East should prevent appropriate legislation to the end that all regions should be made capable of the highest production. The West will use its own productions, and its growth will avoid the competition which our eastern agricultural friends at the present time so greatly apprehend.

CONCLUSION.

From the foregoing brief statement, which by no means covers all of the points of work desirable to be stated in the divisions over which the Assistant Secretary has had special charge, such rapid progress is observable that he congratulates himself on the fact that in small part he has been connected therewith. The topics always changing have been to him highly interesting, so much so that from this point of view, and this mainly, he regrets the severing of his relations with them. His work has been but in the slightest degree perfunctory. He knows more of this great country, of its possibilities, of the obstacles to agriculture, of the means to overcome them—vastly more than he did when he entered upon his duties. The associations have been so pleasant, not only with all connected with the divisions over which he has had special charge, but with all of the officials of the Department, including the Secretary, who has ever been most kind and considerate, that he shall go into private life with a feeling of heartfelt and kindly remembrance.

A few words to close, of suggestion only. One of the duties, as well as one of the pleasures, that both the Secretary and his assistant have been obliged to suspend and forego, should be the more frequent response to demands from all regions of the country that they should appear before and address assemblages interested in the subject of agriculture. The work has been so exacting, and the Secretary and myself have been able to meet this demand to such a limited degree that the effort to do so has been practically abandoned. There is no department of the Government that represents so many people and which should stand so near to them as the Department of Agriculture; and one of the highest obligations imposed upon its head is to meet them and discuss the questions uppermost in their minds. The Department itself would be better understood, and the ties between it and the prac-

tical workers of the soil would be essentially strengthened. The devising of some method for the relief of the Secretary and Assistant Secretary from a large amount of routine labor which could, in my opinion, be made to devolve upon some other officer by an enlargement of the staff of the responsible administration officers of the Department, and perhaps by a reduction in the number of persons with whom the Secretary and Assistant Secretary are compelled to deal directly, would relieve the situation and make possible a more extended personal intercourse between the heads of the Department and the people. No man can be called to the head of this Department who is personally conversant of the needs and demands of the whole country, and nothing will better fit him for a proper adjustment of its work than the personal information which he shall acquire by visiting regions so dissimilar and yet all component parts of a whole included in the sphere of his consideration and proper action.

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